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The Genomic Resources Collection Policy of the Finnish Museum of Natural History

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Abstract

The Genomic Resources Collection is a separate, independently managed part of the natural history collections of the Finnish Museum of Natural History Luomus specifically intended for consumptive research. The GRC policy deals with the materials that are archived for the very purpose of enabling the study of biological diversity at the genome level, DNA extractions of animal, fungal and plant specimens, and animal tissue samples stored deep-frozen for purposes of future DNA extraction. The GRC policy defines the purpose of the collections, the objectives and content of the procedures and activities related to them, the distribution of responsibilities for collection management and maintenance in Luomus, and the principles of collection accumulation, preservation and accessibility.

The aim of the GRC is to store and loan genomic samples for research purposes. In taxonomic coverage the collection overlaps with all the taxonomically delimited specimen collections managed by the Zoology and Botany Units, but is distinguished as being directed to preserve the genomic (DNA) information irrespective of the phenotypic variation that are the focus of specimen collections. The GRC includes both Finnish and foreign samples, all legally and ethically obtained, mostly linked to a specimen voucher in the

taxonomic collections. The GRC samples are documented and trackable in Luomus collections management system. In accordance with the Universities Act, the GRC belongs to the national natural science collections of Luomus. For their part, the GRC collection implement the mission of Luomus, which is to be “responsible for the preservation, accumulation and exhibition of the national natural history collections and for research and education relating to them”.

Keywords

genomic resources collection, DNA sample, animal tissue sample, genomic diversity

1. Status, purpose and implementation of the Genomic Resources Collection Policy at the Finnish Museum of Natural History Luomus

Status and implementation of the Collection Policy

The collection policy of the Finnish Museum of Natural History Luomus is hierarchically organized. General principles and guidelines are defined in the General Collection Policy. Subordinate to that are the collection policies for the partial collections. They adhere to and implement the General Collection Policy while clarifying guidelines and instructions specific to a given partial collection, taking its' unique characteristics into account. The genomic resources collection (hereafter GRC) policy is one of these subordinate policy documents. It deals with the materials that are archived for the very purpose of enabling the study of biological diversity at the genome level, particularly for producing DNA sequences for characterizing taxa and populations. Specifically this refers to DNA extractions (preparations) and to animal, fungal and plant tissue samples stored deep-frozen for purposes of future DNA extraction.

This policy document has been drafted by the GRC Curators, reviewed by the Collections Steering Group, and approved by the Luomus management group on May 4, 2020.

The GRC policy is implemented and executed by the GRC Curators who manage the GRC collection, as well as by staff working with the collections on behalf of Luomus. The GRC policy should be followed by everyone using the GRC, particularly by the collection teams processing the materials and depositing voucher specimens to their separate collections. It should also be followed by all researchers conducting DNA studies at Luomus' premises and in Luomus' research groups.

Goals of the Collection Policy

The goal of the Collection Policy is to ensure the high scientific quality of the collection and associated data, and to enable optimal physical and digital access to the collections for scientific research purposes. The policy document defines the purpose of the collections,

the objectives and content of the procedures and activities related to them, the distribution of responsibilities for collection management and maintenance in Luomus, and the principles of collection accumulation, preservation, accessibility and use on a general level. Detailed instructions for sample and data handling are provided in the GRC handbook. The aim of this policy is not to regulate the use of specimens in Luomus' taxonomic collection sections for molecular work. These regulations / practices are outlined in the separate collection policies for botanical, mycological and zoological specimens. The principles outlined in the Digital Data Policy of Luomus apply also for the GRC sample data.

Definition of the Genomic Resources Collection

Genomic DNA and tissue collections are standard for all larger natural history museum collections, and facilitate standardized, legal access to samples for genetic research. The preservation of genomic samples enables the (direct) use of genomic information in present day and future research questions. Luomus GRC includes both Finnish and foreign samples, all legally and ethically obtained, mostly linked to a specimen voucher and always properly documented and trackable in the collections management system Kotka (hereafter CMS; Heikkinen et al. 2019), and appropriately labelled. Genomic samples include genome preparations (DNA-extracts) and animal tissues samples (or whole organisms).

Purpose of the Genomic Resources Collection

This GRC collection is a separate, independently managed collection section of the biological collections of Luomus. The aim of the GRC is to store and loan genomic samples for research purposes, such as exploring the genomic diversity of species. The GRC samples are worldwide in scope, and are specifically intended for consumptive research. In taxonomic coverage the collection overlaps with all the taxonomically delimited specimen collections managed by the Zoology and Botany Units (vertebrates, invertebrates, insects, algae, bryophytes, fungi and vascular plants), but is distinguished as being directed to preserve the genomic (DNA) information irrespective of the phenotypic variation that are the focus of specimen collections.

Legislation, general principles and strategic policies related to the collections of Luomus are treated in the General Collection Policy (Hyvärinen et al. 2020). In accordance with the Universities Act (2009), the GRC belongs to the national natural science collections of Luomus. For their part, the collections implement the mission of Luomus, which is to be “responsible for the preservation, accumulation and exhibition of the national natural history collections and for research and education relating to them”.

International guidelines

Luomus is an Associate member of the Global Genome Biodiversity Network (GGBN.org), and Luomus GRC constitutes a biodiversity repository in the sense of GGBN (http://wiki.ggbn.org/ggbn/Terms_of_reference): A publicly accessible, curated collection of

biological material (excluding contemporary human material). With its common standards and best practices for genetic collections, GGBN is creating a network of trusted collections.

In collaboration with CETAF (<http://www.cetaf.org>), SPNHC (<http://www.spnhc.com>), TDWG (<http://www.tdwg.org>) and SYNTHESYS+ (<http://www.synthesys.info/>), the GGBN has outlined best practices for biorepositories on meeting the requirements of the Nagoya Protocol (2010) and the regulation for Access and Benefit Sharing (ABS, <https://www.cbd.int/abs/>).

Collection responsibilities

The director of the Zoology Unit carries the primary responsibility for the GRC collection of Luomus – its preservation, accumulation, documentation and use. The responsibilities for the GRC collection are further divided between two Curators (scientific collection managers), the GRC Curator and a Curator belonging to the Metazoa Team. The GRC Curator is responsible for the management of the DNA samples and is supervised by the director of the Zoology Unit. A Curator of vertebrate samples of the Metazoa Team is assigned the responsibility for the management of the vertebrate tissue samples. The team leader of the Metazoa Team carries the overall responsibility for the supervision of work carried out by the Metazoa Team.

The distribution of responsibilities related to the practical collection management of the GRC is governed by the Zoology Unit Director, while the scientific collection managers (curators) are responsible for the supervision of work carried out by Luomus' staff. The practical collection management is documented in the GRC handbook.

2. Principles of accessing material

Material to be added to the collections

New material to the GRC includes DNA-extracts (genomic preparations) remaining from finished scientific research projects by Luomus or other UH researchers, donated by research collaborators, students or governmental institutions, and animal tissues of vertebrates or invertebrates from the incoming flow of specimens to Luomus. Relevant organisms are naturally occurring organisms (wildlife) of worldwide origin.

The voucher specimens from which the DNA or tissue samples are separated are deposited in the different collection sections in Luomus according to their taxonomy. Only the DNA and tissue samples are deposited in the GRC collection. As such, the GRC will comprise three types of samples:

- DNA-extracts (genomic preparations) produced in the course of research projects and deposited for potential further use by the scientific community
- animal tissues (or whole organisms) stored deep-frozen, to serve as a source of future DNA extractions (and potentially other investigations)

- high-quality whole-genome DNA preparations prepared for banking in the GRC

Focus areas of the collection

The focus areas or strengths of the GRC are guided by the principles outlined in the (Hyvärinen et al. 2020). The primary means for collection augmentation is the demand-driven sampling of Luomus' researchers and collaborators. Samples gathered for research in, e.g., molecular phylogenetics are identified by an expert and often rare and difficult to obtain. As a rule, all material relating to research, theses or dissertations completed at Luomus must be documented and submitted to the relevant collection. The GRC will not accept samples with restrictions of use that might interfere with its mission and goals. High-quality and active research will result in genomic samples of high research value (eventually) made available in the GRC.

Quality criteria for GRC samples

The quality criteria for the specimens and associated metadata follow the criteria listed in the General Collections Policy (Hyvärinen et al. 2020). Quality criteria for the samples to be added to the genomic collections include

- the quality level of the taxonomic identification of the voucher specimen
- the reliability and specificity of the locality and other information related to the sample
- the physical quality of the DNA sample (DNA concentration, volume, purity)
- legal and ethics aspects for the samples being met (collecting and other permits, Nagoya Protocol (2010) and CITES (1973) regulations)
- other possible taxon-specific quality criteria

The GRC will mainly acquire DNA (extracts) or tissues samples that are linked with a taxonomically identified voucher specimen deposited in (or to be deposited in) Luomus' collections or in another named national or international repository (preferably public). The taxonomically identified source specimens of the tissue samples are not always deposited in Luomus' collections for reasons of preparation and storage costs. Thus, many tissue samples will lack the link to a physical voucher specimen.

Ethics and legal aspects

All samples to be accepted for incorporation in the Luomus GRC must comply with relevant legal and ethics criteria, both the criteria of the Finnish legislation (including compliance with the Genetic Resources Act) and the legal criteria and provisions of the countries of origin as well as with the international regulations (Nagoya Protocol (2010) of the CBD, CITES (1973)) that Finland has ratified. For samples donated by research collaborators or governmental institutions, the sample donor is obliged to ensure the legitimacy of the donated samples and to provide all relevant documents (research / collecting permits) for depositing in the CMS. Luomus retains the full rights to all accepted samples deposited in the GRC.

3. Accepting samples and adding them to the collection

Adding and databasing samples

The GRC will only accept genomic samples with sufficiently detailed voucher specimen and sample (meta)data documentation following the General Collection Policy and as in this document. The samples must also meet the DNA sample quality requirements as outlined above (and in the GRC handbook). All relevant data (voucher documentation, the legitimacy of the specimens, and specifications of terms of use) must be provided by the donor for the GRC curator to review prior to sample acceptance. Newly collected research material (sample lots) by Luomus or other Helsinki University researchers, or a sample donation by an external research collaborator or a governmental institution, is separately registered as a transaction (with a unique identifier in the CMS, and described as to its content (taxonomy, number of samples). All associated sample documentation, like letter of prior informed consent (PIC), agreement on mutually agreed terms (MAT), material transfer agreements (MTA), collecting permits, research clearance permits, donation letters, documents confirming transfer of title to the material, or export permits should be added to the transaction, as applicable.

Decision-making

The GRC Curator is responsible for the management of the DNA samples, and a Curator of the Metazoa Team is responsible for the management of the vertebrate tissue samples. The duties include the process of reviewing and accepting new samples to the collection, organization of samples into the collections, handling and making decisions on loan requests, de-accessioning of samples when depleted, and the supervision of staff working for Luomus. The principles for adding and accepting vertebrate tissue samples to the GRC are provided in the Vertebrate Collection Policy.

Terms related to accepted specimens

When adding material to the collection, Luomus may agree with the sample donor about an embargo period of up to two years before making it openly available. Such an agreement must be approved by the Director of Luomus.

Collection sample preparation

Collection samples are prepared adhering to recognized practices that guarantee high quality and as good a level of preservation as possible, as recommended by the GGBN. The GRC samples are primarily deposited in deep-freezers (at -80°C), or in conventional freezers (at -20°C) to guarantee optimal, long-term preservation conditions.

4. Collection management

The accessibility and, thus, actual value of a collection depends on the systematic organisation of the specimens and samples, and on organisation of the data that document the collection. Collection management refers to the process of organising and documenting the collections. Adherence to the principles of collection management is monitored, and the practices of management are developed in the teams under the supervision of the team leaders and scientific collection managers and in cooperation with the Biodiversity Informatics Unit of Luomus.

Specimen data and the collection database

Databasing the voucher specimen/unit in the CMS to obtain a Unique Resource Identifier HTTP-URI is a necessary step in adding new genomic preparations to the collection, as the GRC solely comprises samples. The vouchered specimens (if available), the DNA and tissue samples prepared from the specimens, and all related metadata (including sequence accession numbers provided by NCBI GenBank/EMBL-ENA public databases) are cross-linked in the CMS. The DNA data fields necessary to document the DNA or tissue sample in the CMS are described in the GRC Handbook. These DNA data standards and the sample vocabulary follow the published GGBN Data Standard and CETAF.

Specimen-specific data to be recorded

The most important data required for museum specimens are the locality and time of collecting. The GRC does not accept genomic preparations made from specimens with no locality, except under extraordinary circumstances, as determined by the Curators in charge.

The following data are the minimum requirement for specimens from which genomic preparations are made (quality criteria):

- Location of discovery (country, locality, coordinates with accuracy of no less than 1 km²)
- Collecting date (precise date or time period)
- Collector's identity
- Species identification and identifier

Recommended additional information of museum specimens is detailed in the other partial collection policies.

Physical organization of the Genomic Resources Collection

The GRC deep-freezers holding the GRC samples are housed in the freezer room of the Zoology Unit building. The DNA samples are taxonomically organized, and the sample tubes are placed into boxes, which are arranged in separate trays (racks) on the shelves of a dedicated deep-freezer. The tissue sample tubes are placed in boxes in the incoming

order, and similarly organized into a separate deep-freezer, and with a parallel sample placed in a conventional freezer. A computer-based excel sheet inventory system for the deep-freezer sample placement documentation for each deep-freezer and conventional freezer is maintained separately by the GRC Curator for the DNA samples and the Curator of the Metazoa Team for the tissue samples. Printouts of the sample inventory documents are available in the freezer room.

5. Collection maintenance

Collection maintenance is conducted adhering to the international practices in the field. The aim is to ensure the preservation of specimens for a period of decades for the use by the scientific community. This requires specialised methods for sample handling, storage, and the security of the collection facilities.

The GRC is regularly inspected by the Curators to assess its status, good preservation of the samples and to identify potential risks for both freezers and samples. Regular inspection includes monitoring of freezer space, freezer temperatures and sample storage materials.

Deep-freezer failure sample rescue plan

A detection system for deep-freezer failure connected to the University's monitoring center is organized and in place. A deep-freezer failure sample rescue plan is posted in the freezer room and in the main laboratory.

Safety

There is a safety coordinator appointed for the collection facility. The staff has been familiarized with the rescue plan, which is available in written form in the main laboratory. On a general level, occupational safety is controlled by the University's HR organization.

Written guidelines for safe handling of samples stored in deep-freezers are given in the GRC handbook.

6. Accessibility and use of the collections

Accessibility and access rights

Access to the collection is restricted to the Curators and authorized staff. The GRC collections are described in the GRC Theme page <https://laji.fi/theme/luomusgrc> of the species.fi portal of the Finnish Biodiversity Information Facility (FinBIF), where the GRC samples available for research use are searchable.

Openness of data

The metadata related to the collections and, as a rule, the specimen and sample data digitally entered into the CMS, are open data according to the Digital Data Policy of Luomus. They are available to the scientific community and the public through the Finnish Biodiversity Information Facility (FinBIF; species.fi), as a rule according to the licence CC BY 4.0 or newer.

Sample loan policy

Luomus GRC loan policy allows the use of the samples and associated metadata for research purposes only. The GRC loans are consumptive, and only outgoing.

The sample loan requests are evaluated by the scientific collection managers of the GRC, and a decision is made based on the scientific quality of the proposed research and the availability of the requested sample(s). A sample loan request may be 1) approved (but all requested samples may not be provided), 2) returned for revision / updating of lacking information, or 3) denied, if intended use is deemed not scientifically justified.

A GRC loan transaction is facilitated in the CMS and is permanently registered as a sample transaction. The GRC Sample Request form including loan instructions is available from the GRC Theme page <https://laji.fi/theme/luomusgrc/instructions> at the species.fi data portal. The GRC Loan procedure is also described in the GRC Handbook.

For loan of GRC samples the appropriate Material Transaction document is established between the scientific collections managers of the GRC and the researcher. The Material Transaction document defines the ownership of the material, regulates the use of the loaned samples, and specifies the reporting of the results. The Luomus GRC loan policy does not allow the transfer of unused subsamples to a third party. Unconsumed samples must be destroyed by the loaner or returned to Luomus. Luomus may add charges such as mailing costs and / or a handling fee for sending the requested samples according to the requested sample number.

When an essential or critical part of the material of the specified study (e.g. > 30%) is based on Luomus material, the borrower should discuss and agree with the scientific collection managers of the GRC about possible recognition of the contribution of Luomus in terms of co-authorship. In every case, the general rules of fair practice in the scientific community should be followed.

Dissemination and use of resulting data

Researchers utilizing Luomus GRC samples in their research publications are required to submit all obtained genetic sequence or genotype data to a public genetic database, such as EMBL-ENA (<http://www.ebi.ac.uk/ena>) or NCBI GenBank (<http://www.ncbi.nlm.nih.gov/>). In any publication(s) resulting from the loaned material, the origin of the material from Luomus must be acknowledged and appropriate sample identity codes given. A digital

document listing the sample identity and Genbank accession codes from the resulting scientific study should be made available to a GRC Curator.

7. Deaccessioning

GRC samples are deaccessioned when they are depleted or analytically unusable (as a result of unwanted chemical destruction processes during long-time storage). The deaccessioning is documented in the CMS and freezer inventory documents. All specimen and sample data, and the sample transaction and research history, remains documented in the CMS.

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